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ABSTRACT

This paper offers evidence, both empirical and qualitative, linking R. J. Sternberg's Triarchic Theory of Intelligence with H. A. Witkin's Theory of Field-dependence/independence (FDI). Some of the logical arguments are articulated that can be made connecting studies on FDI done in the past with aspects of Sternberg's componential and contextual concepts of intelligence. Focus is on the following issues: (1) FDI-related differences in the ability to structure when structure is not provided; (2) FDI-related differences in dependence on salient cues; (3) FDI as it might relate to practical intelligence; (4) FDI as a matter of intelligence and achievement; and (5) the malleability of FDI characteristics and intelligence. FDI data are presented, which are consistent with some of Sternberg's proposals. The relationship between intelligence and FDI is worth exploring as a way of identifying individuals who might profit from special enrichment programs. (Author/TJH)

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New Perspective on Intelligence: Examining Field Dependence/Independence in Light of Sternberg's Triarchic Theory of Intelligence[1]

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Abstract

This paper offers evidence, both empirical and qualitative, linking Sternberg's Triarchic Theory of Intelligence with Witkin's Theory of Field-dependence/independence (FDI). It articulates some of the logical arguments that can be made connecting studies on FDI done in the past with aspects of Sternberg's componential and contextual concepts of intelligence. In particular it addresses these issues: FDI related differences in ability to structure when structure is not provided, FDI related differences in dependence on salient cues, FDI as it might relate to practical intelligence, FDI as a matter of intelligence and achievement, and the malleability of FDI characteristics and intelligence. It also presents data on FDI collected by the authors which is consistent with some of Sternberg's proposals. The relationship between intelligence and FDI is worth exploring as a way of identifying individuals who might profit from special enrichment programs.

New Perspective on Intelligence: Examining Field Dependence/Independence in Light of Sternberg's Triarchic Theory of Intelligence

The recent shift from a psychometric to a cognitive understanding of intelligence has had an impact on several areas of education research. It has stimulated the research on processes as well as products; it has legitimized the consideration of environmental, developmental, and personality factors as mediators of intelligence, which in turn, has evoked the possibility that intelligence is malleable (e.g., Feuerstein, Jensen, Hoffman, & Rand, 1985; Sternberg, R.J., 1986; Whimbey & Lochhead, 1986).

Intuitively, the concept that intelligence is malleable is very appealing because it is congruent with our educational goal that each person should attain his/her full potential and with our democratic concept that anyone can succeed in our society. More importantly, this possibility is appealing because it is consistent with what we perceive empirically. That is, that individual differences in intellectual achievement exist, but that they do not appear entirely fixed, nor is aptitude alone sufficient to explain them.

The strong appeal of this concept has renewed educators' interest in intelligence. But it has also necessitated theorizing

about intelligence in new ways, ways that take into account the tangential theories which arose while educators were reluctant to speak of intelligence, when they preferred instead to discuss such concepts as learning styles, cognitive predispositions, and right/left brain attributes. The vacuum created by ignoring "intelligence" (in some cases, by judicial decree) was filled with a plethora of alternative hypothetical explanations of individual differences in achievement. Some of these hypothetical explanations have been at least partially supported by empirical research. Consequently, any theory of intelligence must now accommodate these data.

One theory which holds such promise is the triarchic theory of intelligence posited by R.J. Sternberg (1985). It is the purpose of this paper to look at Sternberg's theory, specifically to look at it in light of the research on another theory, Witkin's concept of field dependence/independence (FDI). In addition to the research cited in the literature, current research by the authors is included.

According to Sternberg's theory, intelligent behavior is contextual, experiential, and componential. The contextual aspect of intelligent behavior refers to the concept that individuals act within a sociocultural context (i.e., they are born into a specific

societal environment). In responding to the societal environment in which they find themselves, individuals may choose to adapt to the environment, to select another more desirable environment, or to try to shape the present environment to better meet their needs. The experiential aspect of intelligent behavior refers to the concept that intelligent behavior, in part, is a matter of experience. Both the ability to accommodate novelty and to automatize familiar tasks are related to the amount of experience an individual has with tasks. Lastly, the componential aspect of intelligent behavior refers to the concept that the sources of individual differences in intelligence may be attributed to one of three information processing components or to a combination of these: metacomponents, performance components, and knowledge-acquisition components. It is primarily the componential part of Sternberg's theory that this study purports to link with Witkin's concept of FDI, although some attempt to tie in the contextual component is also appropriate.

"Metacomponents are higher-order executive processes used in planning, monitoring, and decision making in task performance," (Sternberg, 1986, p. 99). Metacomponents are responsible for deciding what to do, how to do it, and if it is done well. In solving analogies, for instance, metacomponents are responsible for

the overall strategy, including how much time should be spent on the processes of encoding, mapping, inferring, and applying.

"Performance components are processes used in the execution of a task," (Sternberg, 1986, p. 99). Performance components are responsible for doing what the metacomponents indicate should be done. Since many behaviors are possible, the number of performance components is quite large, but with regard to measuring intelligence, a few components are more important than others. This is so because these components are general across many tasks found on intelligence tests. For example, one such set of components is inductive reasoning (inferring and applying), common in analogies, classifications, mathematics problem solving, reading comprehension, and various other tasks. Since many different performance components are possible, different components may be used to solve a given task, depending upon the individual's experience and the context of the task.

"Knowledge-acquisition components are processes used in learning new information," (Sternberg, 1986, p. 99). These knowledge-acquisition processes consist of selective encoding, selective combination, and selective comparison. Selective encoding pertains to the ability to separate the relevant from the irrelevant information in a task. Selective combination involves

combining the relevant information in some meaningful and appropriate way. Selective comparison entails relating old to new information.

Witkin's theory of FDI began with studies of individual differences in perception and later was expanded to include cognitive tasks, (Witkin, Moore, Goodenough, & Cox, 1977). Evidence has accumulated indicating that styles of dependence on and independence of the cognitive field are manifested during thinking and problem solving. Although some claims regarding FDI are inconclusive, considerable research has been done which merits attention. Foremost among this research is the research suggesting Field Dependent (FD) persons require structure in the learning setting and that they rely too heavily on salient cues.

Unlike Field Independent (FI) persons, FD persons do not do well when they must impose organization on material to be learned, partially because they have difficulty discriminating between relevant and irrelevant cues. Educationally, this aspect of FDI is very significant. Whereas there is no purported difference between FD and FI persons in general learning ability or memory (Witkin, et al., 1977), there are differences in terms of performance in specific subjects. Particularly acute are the differences in performance in mathematics and science attributed to FI

individuals' ability to perceive and impose structure and FD individuals' dependence on salient cues and their inability to ignore irrelevant cues.

Equally significant but less well studied and, therefore, less well articulated is the difference between FD and FI individuals with respect to social knowledge. Because such knowledge appears not to play too important a role in academic success, it has not been investigated in the same way as formal knowledge. However, since Baron and Sternberg (1987) include social intelligence as an aspect of the contextual component of intelligence, it will be discussed in this paper.

There are then five aspects of Witkin's FDI concept which this paper links to Sternberg's theory. (a) FDI related differences in ability to structure when structure is not provided, (b) FDI related differences in dependence on salient cues which inhibits problem solving when classes or problems require breaking set, (c) FDI as it might relate to practical intelligence, (d) FDI as a matter of intelligence and achievement, and (d) the malleability of FDI characteristics and intelligence.

Beginning with FDI related differences in ability to structure when structure is not provided, the literature on FDI is replete with studies which demonstrate that such differences exist (Frank,

1984; McLeod, Carpenter, McCornack, & Skvarcius, 1978; Nebelkopf & Dreyer, 1970; Pitts & Thompson, 1984). Frank (1984) found that under conditions of no notes, students' notes, outlining framework and students' notes, and complete outlining and students' notes, FI students performed better than FD students when they took their own notes. When compared to other FI students, they did worse without notes, but not significantly better when provided an outline. On the other hand, FD students performed significantly worse when they took their own notes than when a complete outline was provided in addition to their notes. An examination of the subjects' notes led to the conclusion that the notes of the FI subjects were better organized (in outline form) and more efficient (fewer words but equal number of learning units). Similarly, Nebelkopf and Dreyer (1970) found that scores on the Group Embedded Figures Test (GEFT) used to measure FDI correlated with ability to structure and restructure ambiguous stimuli.

Consistent with this differential ability to structure is the differential performance in math and science of FD and FI students (Satterly, 1979; Shipman & Shipman, 1985). Mathematically capable students and experts are known to put a great deal more structure on the knowledge that they retain in long-term memory than do less capable students and novice problem solvers (Chi, Glaser, & Reese,

1982). In fact, mathematics learning is viewed as a generative process involving the construction of organizational structures for storing and retrieving information and the construction of processes for relating new information to the stored information (Wittrock, 1974). FI persons being more capable of such constructive processes are thus more capable in mathematics and science.

This ability to structure material is akin to Sternberg's concept of selective combination, the ability to "encode information in such a way as to form an integrated, plausible whole," (Sternberg, 1985, p 107). Subjects who excel at selective combination can combine disparate bits of information into a unified whole that may or may not resemble its parts.

Such a task was studied in relation to FDI by Annis (1979) who found that FI students scored better than FD students on completion items of high structural importance to the meaning of an entire learning passage. FI students excelled in this task whether the passage was organized or not.

In addition to supporting the link between Sternberg and FDI, the Annis study suggests a concomitant link between mathematics performance and reading performance which may be accounted for in terms of FDI. It has long been recognized that FI persons are

better readers (Pitts & Thompson, 1984) as well as better students in mathematics and science. But explanations other than general inteiligence have eluded theorists until now. It seems plausible that FI persons are better readers because of their ability to access material in long term memory that is more highly structured--in other words, to access more highly organized schemata.

With regard to FDI related differences in dependence on salient cues which inhibits problem solving, again the literature points toward a relationship (Shipman & Shipman, 1985; Witkin, et al., 1977). The nature of the task used to identify field dependence and independence, such as in the Embedded Figures Test, is to decontextualize a specified figure embedded within a geometric configuration. That is, the subject must locate and trace a simple geometric form embedded within a more complex geometric form. In order to do this, it is necessary to select the relevant cues and to ignore the irrelevant ones. Witkin, et al., (1977) note that FD persons have difficulty doing this. They have difficulty breaking away from the dominant complex figure and focusing on the simpler figure. They are dominated by salient cues.

The ability to select the relevant, rather than the salient, cues is important in areas besides the GEFT. Of significance to

this paper is the fact that it is important to performance in reading and mathematics. For example, in mathematics problem solving, students must be able to select the information that is relevant to the solution of the problem and to ignore the extraneous information. In fact, understanding and accurately representing the problem is a matter of being able to identify what is important. This same ability is paramount in reading as well, particularly in acquiring vocabulary in context and in drawing inferences. For both of these processes, it is necessary to decide which information is useful and which information is either not useful or even misleading. Sternberg (1985) refers to this skill as selective encoding. Studies which support the need for selective encoding in problem solving and reading do not always refer to it as selective encoding, but they nevertheless posit the need for this skill (Bransford & Stein, 1984; Mason, with Burton & Stacey, 1982; Palincsar, 1986).

Nothing in the literature specifically addresses the issue of FDI and practical intelligence. In fact, very little attention has been focused on the positive aspects of FD at all except to note that there is a tendency for FD persons to be more socially oriented and adept (Witkin, et al., 1977). With the inclusion of social intelligence as an aspect of the contextual component of

intelligence in Sternberg's theory, it seems more likely that the issue will now be examined. Logically, FD persons appear more likely to manifest such intelligence. FD persons' reliance on context suggests that they are better able to profit from tacit learning, learning outside of the formal learning situation. The difficulty in examining this issue is in finding appropriate empirical measures of social intelligence (Baron & Sternberg, 1987; Witkin, et al., 1977).

The issue of the relationships among FDI, intelligence, and achievement is relevant because of the potential influence of FDI and intelligence on performance. With regard to the relationship between FDI and intelligence, the literature is controversial. A number of studies support the independence of FDI and intelligence (Busch & De Ridder, 1971; Haronian & Sugerman, 1966; Neblekopf & Dreyer, 1973; Vernon 1972; Witkin, et al., 1977), and a number do not (Corah, 1965; Flexer & Roberge, 1983; Jackson, 1957; Powell, 1964). Still it appears that FDI does contribute to performance in certain subjects above and beyond the contribution of intelligence (Goodenough & Karp, 1961; Kagan & Zahn, 1975; Pitts & Thompson, 1984; Satterly, 1976, 1979; Stuart, 1967) as measured by current psychometric measures of intelligence.

Finally, concerning the malleability of FDI characteristics and intelligence, Witkin (Witkin, et al., 1977) does not suggest that FDI is subject to training, although he does indicate that FDI changes with age and may be affected by environmental influences. He also suggests that ability to learn may be increased by altering "learning approaches fostered by cognitive styles," (p. 53). That is, we can enhance certain individuals' chances of learning subjects hitherto deemed too difficult for them by taking into account their cognitive style. He makes no claim that teaching according to cognitive styles is a panacea, but he does suggest that it is possible to "develop greater diversity of behaviors within individuals," (p. 53).

Sternberg (1986), on the other hand, makes a case for the malleability of intelligence. He claims that we teach intelligence to children beginning when they are born, and we attempt to communicate with them and shape their responses. We continue to teach intelligence when we help children learn to function in their complex and ever changing environments. Baron & Sternberg (1987) have expanded the concept of intelligence to include practical intelligence, and, in so doing, have suggested that what we teach to improve intelligence needs to be expanded also. In this matter

Sternberg is in agreement with Witkin. Both theorists would seem to be arguing for more diversity in the classroom.

Methods and Results

Much of the authors' research data was initially collected as part of an ongoing project aimed at examining the potential relationship between FDI and success in school. The subjects were aged 16 to 65. They were predominantly White, but about 20% were minorities, including Black, Hispanic, and Oriental. The data were gathered over a period of two and one half years in a low density western state from students enrolled in adult education courses ranging from Adult Basic Education to graduate school. The results of that project are reported in Tables 1 and 2.

Insert Table 1 About Here

Insert Table 2 About Here

From these tables, it can been seen that FDI was significantly correlated with such diverse indicators of academic success as the Graduate Record Exam, the Test of Adult Basic Education, Schmecks' Deep Processing Learning Style, and a paired associates test.

Additionally, a canonical analysis of some of the data suggested that FDI did contribute to the predictability of performance in a variety of educational settings above and beyond general ability. Likewise, a regression analysis of the GRE data indicated that FDI contributed to prediction of performance on the GRE above and beyond the tests of verbal and mathematical ability (GRE Verbal, Adj R = .74, $p < .001$; GRE Quantitative, Adj R = .76; $p < .001$).

The authors' data, while not initially collected to evaluate Sternberg's theory, nevertheless are consistent with Sternberg's proposal. The increase with age and with level of performance in the correlations between FDI and performance corroborate Sternberg's contention that different aspects of intelligence are operating at different levels of performance and at different tasks. Sternberg (1985) and others (Kail & Pellegrino, 1985) have conjectured that intelligence is comprised of both a general factor and specific factors, a general factor operating at lower level tasks and specific factors operating at higher level tasks. FDI, being a more content specific skill, would in fact be more likely to contribute to performance at higher level tasks.

Discussion

The evidence linking Sternberg's Triarchic Theory of Intelligence and Witkin's Theory of Field-dependence/independence

is sketchy, but what empirical evidence exists adumbrates some intriguing possibilities. First of all, Sternberg's theory provides a new perspective on the phenomenon of FDI, furnishing a rationale for regarding it as an aspect of intelligence. Conversely, the concept of FDI provides support for Sternberg's theory by accounting for aspects of performance not readily accounted for by traditional definitions of intelligence. Additionally, if measures of FDI were to prove to be accurate indicators of social intelligence, they could be used to identify individuals who might profit from special enrichment programs.

This paper has tried to articulate some of the logical arguments that can be made connecting studies on FDI done in the past with aspects of Sternberg's componential and contextual concepts of intelligence. Some of these arguments, such as the ones pertaining to studies on structure and salient cues, are very strong. Others, such as the ones pertaining to social intelligence, are not as strong, but are worth pursuing because they could provide a new perspective on intelligence. If Witkin, et al., (1977) are right and FDI is a bipolar phenomenon with each pole having "adaptive value under specified circumstances," (p. 16), then it ought to be possible to identify individuals and situations where performance can be enhanced by adaptive training.

This seems particularly critical in a world which appears more and more to involve tasks which require competence in social skills as well as cognitive articulation.

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Table 1

Means and Standard Deviations on Group Embedded Figures Test

Sample	n	Mean	SD
Graduate students/statistics class	51	12.13	4.66
Inservice teachers/GRE workshop	60	11.75	4.67
Undergraduate students/education classes	50	11.91	4.64
	54	12.50	4.73
	71	12.20	4.43
Undergraduate students/math review	77	9.99	4.94
Community college students/math review	35	8.20	4.66
	9	11.44	5.32
GED students	26	7.23	4.86
ABE/GED students	62	7.18	4.74
ABE students	27	3.19	3.93

Table 2

Correlations of FDI and Various Measures of Academic Performance

Measure of Academic Performance	r	p
Final grade in statistics class	.41	.002
GRE Test-Verbal	.35	.001
Quantitative	.56	.001
Analytical	.48	.001
CAT Test-Vocabulary	.18	.015
Reading comprehension	.31	.001
Spelling	.04	ns
Language mechanics	.20	.007
Language	.25	.001
Mathematics computation	.19	.010
Mathematics concepts	.42	.001
GED Test-Mathematics	.57	.001
Reading	.26	.050
Writing	.40	.005

(table continues)

Measure of Academic Performance	r	p
Science	.43	.001
Social Studies	.31	.01
TABE Test-Vocabulary	.40	.005
Inference	.30	.01
Paired associates test	.39	.050
Schmeck's Deep Processing Learning Style	.42	.001